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ABSTRACT

With the advent of inexpensive microcomputers, the availability of microcomputers in the schools has mushroomed. Teacher training in the use of microcomputers has not kept pace with the increased availability of computers. There is little current information about how physics and physical science teachers actually use microcomputers in their teaching. Information about this usage and the teachers' perceptions of the values of microcomputers for teaching is valuable for policy planning and in understanding the needs of teachers for increased training and equipment. This study surveyed physics and physical science teachers in Iowa concerning their use of and perceived values related to microcomputers in teaching. Results included information concerning the number of students in teachers' classes, teacher interest in microcomputers, availability of microcomputers, and types of software used. Correlations between teacher interest and usage are reported. Survey data are presented in tabular form. (Author/CW)

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Use of Computers by Physics and Physical Science Teachers

Abstract

With the advent of inexpensive microcomputers, the availability of microcomputers in the schools has mushroomed. Teacher training in the use of microcomputers has not kept pace with the increased availability of computers. There is little current information about how physics and physical science teachers actually use microcomputers in their teaching. While surveys of teacher use of computers are available, they do not focus specifically on physics and physical science teachers' use of microcomputers. Moreover, because the availability of microcomputers is rapidly increasing there is a need to continually update knowledge about their use and teacher's perceptions of their value. Information about physics and physical science teachers current usage of computers in teachings and their perceptions of the values of microcomputers for teaching is valuable for policy planning and in understanding the needs of teachers for increased training and equipment. The present study surveyed physics and physical science teachers in Iowa concerning their use of perceived values of microcomputers. Some major findings were: 1) physics and physical science teachers did not differ in the overall use of and perceived values of microcomputers. 2) Use of tutorials, drill and practice programs, and simulations varied considerably among teachers from almost no use to very extensive use. 3) Almost all teachers had access to a microcomputer on at least a part-time basis. 4) A majority of teachers had access to a computer lab to which students could be sent. 5) Apple II computers were the most commonly available computer by an overwhelming margin. 6) In terms of their perceived educational value, uses clustered into three significantly different groups: Most valued -- interfaced with equipment for data collection, word processing by the teacher, graphics and plotting, in-class demonstrations, simulations of experiments, data analysis; Intermediately valued -- keeping grading records, word processing by students, tutorial programs, drill & practice programs; Least valued -- computer games.

Use of Computers by Physics and Physical Science Teachers

Over the decade of the 1980s, microcomputer availability and use in the schools increased dramatically (Becker, 1983; 1985; 1986; 1987; Dickey and Kherloplan, 1987). In the 1983 National Survey of Microcomputer Use, Becker (1985) reported that nearly 70% of schools had at least one microcomputer, but that the majority of schools with microcomputers had fewer than 5. In the 1985 National Survey of Microcomputer Use, Becker (1986) reported that a majority of elementary schools had more than 5 microcomputers and a majority of secondary schools had 15 or more computers. A quarter of U. S. schools had sufficient computers to teach 1/2 to one full classroom simultaneously (p. 2).

Dickey and Kherlopian (1987) surveyed mathematics, science, and computer teachers on the use of computers in grades 5-9 classrooms. In that study, 25% of the science teachers in these grade levels had access to computers and used them; 37% had access but did not use them, and 38% did not have access. The most frequent type of program used was drill and practice (50%), followed by tutorials (35%), classroom demonstrations (35%), educational games (24%), simulations (24%), problem-solving software (24%), and programming (18%). Lehman (1985) reported that 41% of science faculty in a sample of 193 high schools did not use microcomputers in teaching; in rural schools, microcomputer use was less frequent, 52% of the science faculty had not used computers in teaching. Ellis and Kuerbis (1987) concluded that implementation of microcomputer use by science teachers was disappointing.

Despite the number of surveys of computer use by teachers, no survey has looked specifically at the use of microcomputers in teaching physics and physical science. Physics represents a subject matter that has precise mathematical models and physical equipment that can be readily graphically represented on a video monitor. Thus, physics is an subject matter for which simulations can easily be developed. In fact, some of the earliest uses of computers in instruction involved simulations and tutorials in physics. In addition, physics is an area in which the computer can also be readily be put to use as a data collection device. By interfacing the computer with laboratory equipment, detailed and extensive measurements may be obtained more easily. Moreover, as one of the fundamental sciences, physics is a subject matter of national concern. American students seem to take physics less frequently than do students in other industrialized countries and demonstrate less knowledge of physics. Because of higher salaries available in industry, there is a shortage of well qualified physics teachers. Because of the importance of physics and because physics is an area to which computer assisted instruction may be readily adapted, a survey of how physics teachers use computers at the present time could yield valuable information for policy makers. Because physics is a major component of middle school/junior high school physical science, it seemed important to include physical science teacher in the

sampling.

In the present study, physical science and physics teachers in Iowa were surveyed to determine how they used computers in teaching. The study was descriptive and sought to answer these questions. What is the extent of computer use among Iowa physics and physical science teachers; how familiar are Iowa teachers with and how expert do they perceive themselves to be about computers; what software do teachers use and what types of software do they see as most instructionally valuable? In addition, the teacher were also asked to report some demographic data about their districts, schools, and classes and to indicate how interested they were in learning more about using computers in teaching.

Method

Subjects The initial sample consisted of 670 teachers of physics or physical science in Iowa. This sample was generated from the master list of teachers maintained by the Iowa Department of Education and included every teacher in Iowa listed as teaching physics or physical science. In order to keep the time commitment requested of any teacher manageable, this sample was divided into three subsamples. Each subsample received a separate questionnaire that consisted of approximately one-third of the items we had prepared. The list of names were ordered by zip code and then alphabetically. The subsamples were generated by grouping this list into sets of three and assigning the first member of each set to subsample 1 (n=224), the second member to subsample 2 (n = 223), and the third to subsample 3 (n = 223). In this way the subsamples were generated with approximately equal representation of all areas of the state. Five questionnaires from subsample 1, five questionnaires from subsample 2, and 8 questionnaires from subsample 3 were returned indicating that the recipient did not teach physics or physical science. This left samples of 219, 218, and 215 respectively. Usable questionnaires were returned from each of the samples as follows: subsample 1, n= 145, rate = 66%; subsample 2, n = 98, rate = 44.9%; subsample 3, n = 85, rate = 39.5%.

Questionnaires Each subsample received a different questionnaire, labeled QA, QB, and QC, respectively. The first 7 and last 2 items were repeated across all three questionnaires and requested background information number of students taught in physics, in physical science, in the school and school district, the grade levels taught, and subjects taught in the current academic year. The last two items asked teachers how much interest they had in learning more about computers and in attending a potential summer workshop about using computers in teaching.

Questionnaire A (QA) contained 8 more items, many of which allowed multiple responses. These items concerned the number of computers available to the teacher on a permanent or shared basis, whether a computer lab was available and the number of computers it contained, and the teacher use of and valuing of

different uses of computers in teaching physical science or physics. In separate sections for physics and physical science, teachers were asked to described whether they had ever used computer for: in-class demonstrations, student drill, tutorial programs for students, simulations of experiments, computer games, interfaced with equipment for data collection, for graphics and plotting, teacher word processing, student word processing, and grading. Teachers were also asked to indicate how much they valued each of these uses of computers by rating each use on a nine point scale (1 did not need or value -- 9 very strong need or val e).

Questionnaire B (QB) contained 26 items including the common first 7 and last 3. The unique items on QB asked respondents: 1) to name any software they had used in teaching, 2) to indicate how many computer projects and traditional laboratories students in physics and in physical science completed during the year, and 3) the name of the texts used in physics and in physical science.

In addition to the common items, questionnaire C (QC) asked teachers: 1) if a computer support person were available to them through their Area Education Agency, 2) if they had used that person's services, 3) which peripheral equipment was available, and 4) to rate their knowledge of computers. Teachers were also asked to identify up to two demonstrations or laboratory experiments they found particularly valuable and up to 2 common misconceptions students had before studying physics or physical science.

The questionnaires were prepared in packets that also contained a cover letter explaining the study and asking teachers to participate. A stamped, addressed envelope was included so that teachers could return the questionnaires. Each return address envelope was numbered and this number corresponded to the teachers number on the master list. Teachers were informed that their questionnaire would be separated from their envelope immediately upon its return. The number on the envelope was used to return a summary of the study to teachers who requested it.

<u>Procedure</u>. The questionnaire packets were mailed bulk rate to teachers in the original sample. Approximately 1 month after the initial mailing, teachers were mailed a postcard which thanked those who had returned the questionnaire and urged the others to do so.

Results

As a first step in the data analysis, comparisons were made between teachers who taught only physics, only physical science, or both physics or physical science on all of the other variables for which it was meaningful to do so. Except in the few cases noted below, these three groups did not differ significantly from each other on any of the variables. For this reason, these three groups are combined in most of the descriptive data below. In addition, the three subsamples were compared on the common questionnaire items (numbers of students in physical science, physics, school, district, interest in computers, and interest in an inservice). There were significant differences between the samples on these variables. Because these sampling variations may influence interpretation of the descriptive data, they are

presented first.

Number of Students

The numbers of students in physical science, physics, in the school, and in the district for each subsample are presented in Table 1. One-way ANOVA performed on these data indicated that the samples did not differ in the number of physical science students taught, but did differ in the number of physics students taught, F (2, 243) = 4.50, $p < .0121$, MSc = 632.913. Newman-Keuls follow up tests revealed that respondents from subsample 2 taught more physics students on the average than did respondents in subsamples 1 or 3, who did not differ from each other. It should be noted that the effect is quite small, it accounts for only 3% of the variance and the effect size value is 0.42. The average number of students in the schools did not differ significantly; but the reported average number of students in the districts did differ significantly, F (2, 300) = 13.67, $p < 0.0010$, MSe= 6497865.427. The degrees of freedom in the analyses differ because not all respondents answered all items. Many respondents left blank the items requesting the number of students in the school and in the district.

Interest

Table 1 also reports the average interest teachers had in learning more about computers and in attending a paid workshop to learn more about computers. One-way ANOVA indicated that the subsamples differed significantly in the amount of interest in learning more about computers, F (2, 321) = 3.67, $p < 0.026$, MSe = 0.384. According to a followup Newman-Keuls test, teachers in subsample 1 displayed more interest than did teachers in subsample 3. Teachers in subsample 2 did not differ significantly for the teachers in either subsamples 1 or 3. It should be noted that the difference between subsamples 1 and 3 was quite small and accounted for only 2.2% of the variance. The effect size, using the square root of the pooled variance estimate as the denominator, was .34, a weak to moderate size effect using Cohen's (1977) criteria.

The subsamples also differed in the amount of interest expressed in attending an inservice dealing with computers, F (2,320) = 3.20, $p < 0.042$, MSe = 0.571. A follow up Newman-Keuls test revealed that subsamples 1 and 2 differed significantly, but that subsample 3 did not differ from either subsamples 1 or 2. Again the effect was weak; it accounted for only 1.9% of the variance and the effect size was .33.

Table 2 summarizes the data for Subsample 1. Table 2-Part 1 indicates that number of students taught in physical science and physics and the number of students in the school and district. On the average, fewer students were taught in physics than physical science. The data also indicate the rural nature of the majority of Iowa schools. The average school was about 400

pupils and the average district was about 1300 students. However, there was considerable variation about these means; the standard deviations are approximately as large as the means.

Table 2-Part 2 indicates the percentage of teachers who reported teaching at each grade level. The majority of teachers in Subsample 1 taught in more than one grade, but most of the teaching was in grades 9-12. Table 2-Part 3 indicates the percent of teachers who reported teaching different subject matters and the number of students they reported teaching. As can be seen the majority of teachers taught more than one subject and a considerable range of subjects were taught.

Availability of Computers

Table 2-Part 4 describes the availability of computers. As reported, 42% of the teachers had at least one computer permanently assigned to their classroom (Mean = 1.57); 58% had a computer that could be brought into their room on a shared basis (Mean = 4.49), and a computer laboratory was available in 83% of the schools. In such schools, approximately 16 computers were available in the laboratory and about 83% of the respondents indicated that they could schedule the laboratory for exclusive use (Table 2-Part 6). Table 2-Part 5 indicates the types of computers available. As was expected, the Apple II family of computers predominated, 83% of the respondents who had a computer in their classroom indicated having an Apple II, and among respondents who had access to a shared computer, 86% reported having access to a Apple II. Apple IIs were also the most common computer in computer laboratories; about 82% reported that there were Apple IIs in the computer laboratory. Among computers assigned to the classroom, the category other (8%) was next most frequent followed by MSDOS machines (3.4%) and Commodore 64/128 (3.4%). Macintosh (5.4) and MSDOS machines (3.8) were the computers next most frequently reported as being available on a shared basis. Macintosh (6.8%) and MSDOS machines (6.8%) were also next most frequently available in computer laboratories.

Types of Software Used

Table 2-Part 7 indicates the percentage of teachers who have used different types of software in teaching physical science. Among teachers who used computers, the most frequent use was teacher word processing (98%), followed by inclass demonstrations (94%), drill and practice programs (76%), grading records (72%), tutorial programs (65%), and simulations (61%). Using computers for data collection with an interface device was reported by 40% of the physical science teachers. Table 2-Part 9 reports the uses of different types of software in teaching physics. Some types of software were popular in teaching physics as well as physical science; but there were some important differences. Simulations (91%) were the most frequently reported use, followed by teacher word processing (88%) and in class demonstrations (88%), graphics and plotting (76%), drill and practice programs (75%), data collection with interface device (74%), grading

records (72%), tutorial programs (61%), and data analysis (54%). The differences between the uses in teaching physical science and physics are consistent with the differences in emphases in the two subject matters. Physics typically has a stronger quantitative and experimental emphasis as compared to physical science. The differences between the uses in physical science and physics were tested for each use using an ANOVA. Use in physical science and physics differed significantly for Simulations,
$F(1,143)=14.35$, $p<.01$, $MSe = 0.2169$.
The mean for use in physics was 0.56 and for physical science was 0.26. Physics and physical science also differed significantly in the use of the computer to interface with other equipment for data collection
$F(1,143) = 26.66$, $p<.01$, $MSe = 0.1931$.
Again, use in Physics (Mean = 0 57) exceeded use in Physical Science (Mean = 0.19). Using the computer for data analysis also differed significantly between physics and physical science, $F(1,143) = 14.66$,
$p < .01$, $MSe = 0.168$. Again, the use in Physics (Mean = 0.40) exceeded the use in Physical Science (Mean = 0.13). Finally, using the computer for graphics and plotting occurred significant more often in Physics (Mean = 0.54) than in Physical Science (mean = 0.18), $F(1,143) = 23.81$, $p < .01$, $MSe = 0.19$.

Table 2-Part 8 and Table 2-Part 10 presents the mean reported value teachers perceived in each of the types of computer uses for physical science and physics teachers respectively. These data were analyzed using a Type of Subject Matter (physical science versus physics) by Type of Use (e.g. word processing, simulations, etc.) ANOVA. Neither the Type of Subject Matter main effect nor the Type of Subject Matter by Type of Use interactions were significant. For this reason, the data for physical science and physics teachers were combined into single type of use repeated measures ANOVA; there was a significant effect of Type of Use. The Newman-Keuls procedure was used to compare the different uses to each other. Table 2-Part 11 presents the results of this Newman-Keuls analysis; means that have a common letter do not differ significantly ($p < .05$). As can be seen in Table 2-Part 11, six uses: Data Collection with Interface, Teacher Word Processing, Graphics and Plotting Data, In Class Demonstrations, Simulations, and Data Analysis, were the most valued by the physics and physical science teachers. Computer Games was the least valued use.

Subsample 2: Demographic Data

Table 3-Part 1 and Part 2 reports the mean number of students taught in physics and physical science, the mean numbers of students in the school and district and the grade levels taught for teachers in subsample 2. The pattern is similar to subsample 1.

Frequency of Computer Use

Table 3-Part 3, Part 4, Part 5, and Part 6 report the number of hours and number of activities students in physics and physical science completed using simulations, tutorials or drill and

practice software, and traditional (non-computer) laboratory exercises. The differences between the types of class (physics and physical science) and types of software were tested using a mixed (between-within) ANOVA for both number of hours and number of activities. These analyses are presented in Table 3 - Parts 7 and 8. Only the effects of Type of Software was significant. Students spent considerably more hours in traditional laboratory activities and completed more traditional laboratory experiences than they spend in using either simulations or tutorials/drill software. The means are reported in Table 3-Part 6.

Software Used Table 3-Part 9 reports the number and percent of teachers who listed software that they had used; slightly over two-thirds of the sample listed at least one piece of software. Many respondents took the time to produce extensive list of software use. Table 10 list the software that teachers reported using and the frequency with which each piece of software was report. A wide variety of software was reportedly used. In order to determine the types of physics topics for which software was used, the list of software in Table 10 was examined and frequently occurring topics were compiled. Table 11 reports the categories into which the software was compiled and the frequency of reported use. Because it was not possible to tell from the teachers' descriptions, no distinction was made between tutorial, drill, or simulation software. Software dealing with motion and kinematics was the most frequently used category with 22 reported uses. Software dealing with graphing, vectors, and light/optics were also frequently used.

Respondents in subsample 2 were also asked to report the text they used. Table 9 reports the frequencies with which various texts were used. Heimler's and Price's text, Focus on Physical Science was the most frequently used physical science text by a wide margin. Murphy et al.'s Physics: Principles and Problems with 33 reported users and Metcalfe's and Doll's Modern Physics with 22 users were the most frequently reported physics texts.

Subsample 3: Demographic Data

Table 4 - Parts 1 and 2 report the number of students per class, school, and district and the percentage of teachers who teach at different grade levels. These data are similar to the patterns for Subsamples 1 and 2.

Computer Support Person

Table 4 - Parts 3 and 4 indicate the percentage of teachers who reported having a computer support person either in their AEA, district or school and the percentage of teachers who have used the services of the support person. Nearly 90% of the teachers reported having a computer support person available. However, only 56% of the sample had used the service.

Peripheral Equipment Available

Table 4-Part 5 list the percentage of teachers reporting access to different peripheral equipment. The overwhelming majority of teachers reported access to a printer (95%). A mouse was then next most frequently available type of peripheral equipment (47%) followed closely by an interface card for laboratory equipment (42%). Fewer than 20% of the teachers reported access to plotters, koala pads, or modems. A relatively large percent of the teachers reported access to videotape equipment as peripheral equipment (36%); however, we are concerned that teachers may not have realized that the item referred specifically to videotape equipment that may be accessed and interfaced with the microcomputer. This value may represent an overestimate of the amount of interface-able videotape equipment available.

Table 4-Part 6 reports the teachers self-rated familiarity and expertise with different types of software including: word processing, spreadsheets, data base, graphics, tutorials, simulations, BASIC programming, other high level language programming, and assembly language programming. Teachers rated their familiarity on a 4 choice scale; Table 4-Part 6 reports the percent of teachers choosing each choice for each type of software. Table 4-Part 7 reports the mean familiarity rating for each type of software. A repeated measures ANOVA on this data indicated that there were significant differences between the types of software in terms of rated familiarity (see Table 4-Part 8). Follow-up Newman-Keuls test were conducted to determine which the types of software that differed significantly from other types. The results of these tests are shown in Table 4-Part 7. Types of software with a common following letter do not differ significantly.

Correlations

Table 5 reports correlations between interest in using computers more and in a computer inservice and size of school and district. We had speculated that teachers in smaller schools or district might feel a greater need for inservices. This speculation was not confirmed. The correlations were small and not consistent in direction across the subsamples.

Table 6 reports correlations between number of students in physical science, physics, in the school, and in the district, and the number of computers in the laboratory, number of grade levels taught, and perceive valued of drills, tutorials, and simulations. Number of computers in a computer lab had small positive correlations with number of students in the class, school, and district. Number of grade levels taught had small negative correlations with number of students in the class, school or district in both subsample 1 (Table 6) and subsample 2 (Table 7). Number of physics students taught, number of students in the school, and number of students in the district correlated negatively with the perceived value of drills, tutorials, and

simulations. Number of physical science student taught did not relate to perceived value. In general, teachers in smaller districts and schools perceive greater value in using computer software in teaching physics. Table 8 reports correlations between district size and rated familiarity with different types of software. In general, teachers in larger districts reported greater familiarity with different types of software.

Discussion

The primary purpose of this study was to describe the frequency and use of computers among physical science and physics teachers in Iowa. As previous research has suggested, computers are available to a large majority of physics and physical science teachers; 58% had at least one computer (Mean = 4.5 computers) that could be brought into the classroom for teaching purposes; 40% had a computer permanently assigned to their classroom; and 83% indicated that a computer laboratory was available in their school. That computer laboratory could be scheduled for exclusive class use in 80% of the cases. As expected, Apple II computers were the frequently available computer by a wide margin.

The fact that the Apple II computers predominate in schools by such a wide margin does raise problems for the future development of effective instructional computing in physics and physical science. The Apple II computer was designed more than a decade ago and is a considerably less powerful platform that other more recently developed computers. The limitations of the Apple II reduce the power that programmers can build into software for the Apple II. While the newer Apple II GS significantly improves the power of the Apple II line, it is still less powerful than available Macintosh or MSDOS computers. On the other hand, schools have a considerable capital investment in Apple IIs and the funding to change lines is questionable. The low level of computing power available in schools and the economics of switching to another computer line raise policy issues that should be considered by educational decision makers in upcoming years.

A large majority of teachers had made some direct or indirect use of computers in teaching; only 38.6% of the teachers said they had never used a computer in teaching physical science and only 23% of the teachers said they had never used a computer in teaching physics. Among physical science teacher, the most frequent uses of computers were for word processing and for in-class demonstrations. Among physics teachers, the most frequent uses were for simulations, teacher word processing, and in-class demonstrations. Physics teachers made significantly more use of computers for simulations, interfacing with laboratory equipment, data analysis, and graphics. These differences are consistent with the emphases in teaching physics and physical science.

Physics and physical science teachers did not differ in the value they perceived in different types of software. As a whole, the teachers valued interfacing, word processing, graphics, in-

class demonstrations, simulations, and data analysis the most; they valued computer games the least. Grading records, student word processing, tutorial programs, and drill and practice were valued at an intermediate level. Both physics and physical science teachers used student interactive computer activities such as simulations and tutorials significant less frequently than they used traditional laboratory activities. A very wide variety of software was used, with no single piece of software predominating in reported use. However, software involving motion and kinematics, light and optics, graphing, and vectors were the most common categories of software teachers reported.

The limited number of computers assigned to physical science classrooms and laboratories may inhibit instructional computing uses that teachers find desirable. Physics teachers view interfacing the computer with laboratory equipment for data collection and analysis as an important use. Computers in a computer laboratory probably cannot be used for such purposes. Given that limited computers are available, it is difficult to see how much use of interfacing can be made. Interfacing projects may work best when small groups of students can work on a project. Such a use may require several computers attached to laboratory equipment. The physical resources required to use instructional computing in this way may not be available for the majority of teachers.

The wide variety of software used and the diversity of software publishers may indicate a problem. With this great diversity, it is likely that the software used differs widely in ease of use, user friendliness, and the nature of the human interface. If teachers and students have to learn a new interface for each new piece of software, the learning effort of students and teachers is increased and dissipated across learning tasks that have little educational importance. Learning physics is important. Learning to use different pieces of software is not. This diversity may suggest a need for educational policies that would facilitate the development of larger scale packages that employ a common interface across a wider variety of physics topics.

Teachers rated themselves most familiar with word processing software and least familiar with assembling language programming. However, apparently teachers don't feel very expert with software. The mean rating for word processing barely exceeded the midpoint of the scale and only 22% of the teachers rated themselves as expert with word processing. Database software, tutorials, spreadsheets, simulations, and the BASIC programming language were the types of software that teachers rated themselves as next most familiar with. Again, teachers did not see themselves as very familiar with these types of software. None of the mean ratings for these items exceeded the midpoint of the rating scale and 11% or fewer of the teacher rated themselves as expert on any of these items. The low level of familiarity teachers had with various types of software suggest a continuing need for inservice and other continuing education experiences.

Computers were somewhat more common in larger schools and districts, but the magnitude of the correlations was not large.

Teachers in smaller schools and districts were somewhat more likely to teach a wider range of grade levels. This findings makes sense; in smaller schools, there may no be a sufficient number of students available in one grade level to occupy a teacher full time. However, the magnitudes of the correlations were not large. Teachers in larger district rated themselves as more familiar with different types of software; teachers in smaller schools and district tended to rate the value of software higher. Perhaps teachers who have a greater familiarity with software are more likely to understand the problems and limitations of available software. On the other hand, these data may indicate that teachers in smaller district may need more support to develop effective computer uses in physics or physical science.

These data should be interpreted somewhat cautiously. They are based on three samples of the entire population of teachers of physical science and physics taken during late 1988 and early 1989. A third of the population of physics and physical science teachers each received a separate questionnaire. The response rate was 66% for one of the samples, but only 44% and 40% for the second and third samples respectively. Questionnaire 2 and 3 required that teachers produce longer written responses, while questionnaire 1 contained only short response items. Teachers may have perceived that questionnaires 2 and 3 required more work and, as a result, may have been more likely to not complete these two questionnaires.

In summary, the present data show that a majority of physics and physical science teacher are making some use of computers in teaching. The numbers of computers available may limit their use for some categories of use. While most schools have a computer lab available, few teachers have multiple computers available in the physics laboratory or physical science classroom. At the physical science level, teacher word processing, in-class demonstrations, and drill programs are the most common uses. At the physics level, simulations, teacher word processing, and in class demonstrations are the most common uses. Overall, the instructional computing use that physical science and physics teachers perceived the most value in was interfacing the computer for data collection. However, this use did not differ significantly in perceived value from teacher word processing, graphics, in-class demonstrations, simulations, and data analysis. Other uses were perceived of as significantly lower in instructional value. On the average teachers rate themselves as having introductory familiarity with most software; the exceptions is word processing where teachers perceive themselves as having moderate familiarity. Teachers in smaller schools perceive somewhat more value in educational software, but also rate themselves as somewhat less familiar with software.

References

Becker, H. J. (1983). Schools (sic) Uses of Microcomputers: Report #1 form a national survey, The Journal of Computers in Mathematics and Science Teaching, Fall p. 29-33.

Becker, H. J. (1985). How Schools Use Microcomputers. Summary of the First National Survey. Baltimore, MD: Johns Hopkins University, Center for Social Organization of Schools. (ERIC Document Reproduction Service No. ED 257 448)

Becker, H. J. (1986). Our national report card: Preliminary results for the new Johns Hopkins survey, Classroom computer learning, Jan, 30-33.

Becher, H. J. (1987). Using computers for instruction, Byte, Feb., 149-162.

Dickey, E. and Kherlopian, R. (1987). A survey of teachers of mathematics, science and computers on the uses of computers in grades 5-9 classrooms, Educational Technology, 21, 10-14.

Ellis, J. D. and Kuerbis, P. J., (1987). Encourage Literacy of Science Teachers in the Use of Microcomputers (ENLIST Mi cros). (Final Report. NSF-MDR-8470061). Boulder, CO: Biological Science Curriculum Study. (ERIC Document Reproduction Service No. ED 287 732).

Ingersoll, G. M. Smith, C. B. & Elliot, P. (1983). Microcomputers in American public schools, Educational Computer, 3, 29-31.

Lehman, J. R. (1985). Survey of microcomputer use in the science classroom. School Science and Mathematics, 85, 34-45.

Table 1

Number of Students in Physics Physical Science, in the School and in the School District and Interest in Computers and a Computer Inservice	Mean	SD	SIG
Physical Science			
Subsample 1	50.0	33.7	A
Subsample 2	55.9	39.9	A
Subsample 3	61.1	44.4	A
Physics			
Subsample 1	19.0	17.8	A
Subsample 2	29.7	33.8	B
Subsample 3	20.3	23.9	A
School			
Subsample 1	395.8	298.8	A
Subsample 2	513.2	447.3	A
Subsample 3	454.8	376.7	A
District			
Subsample 1	1286.1	1658.8	A
Subsample 2	2194.9	2876.0	B
Subsample 3	2562.4	3367.8	B
Interest In Learning More About Computer			
Subsample 1	3.69	0.57	A
Subsample 2	3.48	0.70	B
Subsample 3	3.60	0.61	AB
Interest in a Computer Inservice			
Subsample 1	3.59	0.69	A
Subsample 2	3.34	0.83	B
Subsample 3	3.46	0.77	AB

(Means with a common letter in the Sig column are not significantly different.)

Table 2

Means and Standard Deviations and/or Frequencies for Questionnaire Items For Subsample 1.

1. Number of Students In	Mean	SD
Physical Science	33.1	36.2
Physics	20.6	19.9
School	395.8	298.8
School District	1286.1	1658.8

2. Grade Levels Taught	Percent
K-Sixth	1.3
Seventh	11.7
Eighth	15.2
Ninth	62.8
Tenth	55.2
Eleventh	84.2
Twelfth	84.1

3. Subjects Taught	Percent	Grade Levels			Mean Number of Students
		K-6	7-8	9-12	
Elementary Science	13.1		x	x	39.4
Life Science	11.0		x	x	33.3
Earth Science	13.8		X	X	39.4
Physical Science	55.0		x	x	47.3
General Science	12.4	x	x	x	30.4
Biology	22.8			x	29.1
Chemistry	62.1			x	32.4
Physics	73.8			x	20.6
Other Course	41.3		x	x	26.7

Table 2 Continued

4. Teacher Has a Computer Available in Classroom	Percent	Number of Computers Mean	SD	Range Min	Max
Permanently Assigned to Classroom	42.8	1.57	1.41	1	8
Shared on Need Basis	57.9	4.49	5.79	1	30
The School Has A Computer Lab Available	83.4	15.84	8.21	2	50

5. Brands of Computers Available	Assigned To Classroom Percent	Shared Percent	In Computer Lab Percent
Apple II family	83.0	86.1	81.5
Commodore 64/128	3.4	1.5	2.0
Macintosh	1.1	5.4	6.8
Atari 520/1040	0.0	0.0	0.0
IBM - MSDOS	3.4	3.8	6.8
Radio Shack	1.1	0.8	0.7
Commodore Amiga	0.0	0.8	0.7
Atari 400/800	0.0	0.0	0.0
Other	8.0	1.5	1.4

	Percent Yes Full Sample	Percent Yes With Comp. Lab
6. Can the Computer Lab Be Scheduled For Exclusive Class Use	65.5	79.8

Table 2 Continued

	Percent Yes of Physical Science Teachers Full Sample	Computer Users
7. Teacher use of Computers in Physical Science.		
Never Used	38.6	
In Class Demonstrations	58.0	94.4
Drill and Practice Programs	46.6	75.9
Tutorial Programs	39.7	64.8
Simulations	37.5	61.1
Computer Games	19.3	31.5
Data Collection w/ Interface	25.0	40.7
For Data Analysis	20.0	33.3
For Graphics and Plotting	27.3	44.4
For Teacher Word Processing	60.2	98.1
For Student Word Processing	29.5	48.1
For Grading Records	44.3	72.2
Other	4.5	7.4

	Mean Rating	SD
8. Perceived Value of Various Applications For Teaching Physical Science 1 No Value -- 9 strong value		
In Class Demonstrations	6.22	2.36
Drill and Practice	5.46	2.20
Tutorial Programs	5.49	2.02
Simulations	6.24	2.17
Computer Games	2.43	1.79
Data Collection w/ Interface	6.11	2.50
Data Analysis	5.36	2.46
Graphics and Plotting Data	5.86	2.36
Teacher Word Processing	6.54	2.95
Student Word Processing	5.71	2.82
Grading Records	5.85	2.94

9. Teacher use of Computers in Physics.	Percent Yes of Physics Teachers Full Sample	Percent Yes of Physics Teachers Computer Users
Never Used	23.0	
In Class Demonstrations	67.0	87.5
Drill and Practice Programs	61.7	75.0
Tutorial Programs	46.8	61.1
Simulations	70.2	91.6
Computer Games	22.3	29.2
Data Collection w/ Interface	56.4	73.6
For Data Analysis	41.5	54.2
For Graphics and Plotting	58.5	76.4
For Teacher Word Processing	67.0	87.5
For Student Word Processing	35.1	45.8
For Grading Records	55.3	72.2
Other	3.2	4.2

10. Perceived Value of Various Applications For Teaching Physics 1 No Value -- 9 strong value	Mean Rating	SD
In Class Demonstrations	6.52	2.37
Drill and Practice	5.45	2.17
Tutorial Programs	5.55	2.22
Simulations	6.35	2.25
Computer Games	2.64	2.07
Data Collection w/ Interface	7.35	2.17
Data Analysis	6.54	2.17
Graphics and Plotting Data	6.84	2.09
Teacher Word Processing	6.86	2.65
Student Word Processing	5.71	2.63
Grading Records	5.60	3.05

Table 2 Continued

11. Means and SDs on Perceived Value of Various Applications Combined Across Physics and Physical Science Teachers
1 No Value -- 9 strong value

		Mean Rating	
6	Data Collection w/ Interface	6.99	A
9	Teacher Word Processing	6.71	A
8	Graphics and Plotting Data	6.53	A
1	In Class Demonstrations	6.39	A
4	Simulations	6.36	A
7	Data Analysis	6.30	A
11	Grading Records	5.67	B
10	Student Word Processing	5.59	B
3	Tutorial Programs	5.51	B
2	Drill and Practice	5.45	B
5	Computer Games	2.64	C

[a] means with a common letter are not significantly different ($p < .05$)

Table 3

Means, Standard Deviations, or Frequencies for Items in Subsample 2.

1. Mean Number of Physics & Physical Science Students Taught and Number of Students in The School or District	Mean	Standard Deviation
Physics Students	23.3	32.3
Physical Science Students	33.4	41.3
Number of Students in School	513.2	447.3
Number of Students in District	2194.9	2876.0

2. Percent of the Sample That Teaches at Each Grade Level	Percent
K-Sixth	1.0
Seventh	9.2
Eight	16.3
Ninth	51.0
Tenth	47.9
Eleventh	79.5
Twelfth	60.6

Table 3 continued

	Physical Science N	Physical Science %	Physics N	Physics %
3. Frequency of Use Of Types of Instructional Computing and Laboratory Activities				
3a. Simulations Number of Hours				
None or No Response	15.0	25.8	0.0	0.0
0-3	17.0	29.3	15.0	19.5
3-5	6.0	10.3	11.0	14.3
5-10	5.0	8.6	15.0	19.5
10-15	5.0	8.6	6.0	7.8
15 or more	10	17.2	30.0	39.0
3b. Number of Simulations				
1	16.0	27.5	3.0	3.9
2	9.0	15.5	11.0	14.3
3	4.0	6.9	9.0	11.7
4	7.0	12.1	[illegible]	16.9
5	8.0	13.7	12.0	15.6
more than 5	14.0	24.1	29.0	37.7
3c. Tutorials or Drill Number of Hours				
None or No Response	14.0	24.1	0.0	0.0
0-3	25.0	43.1	34.0	44.2
3-5	6.0	10.3	10.0	13.0
5-10	4.0	6.9	16.0	20.8
10-15	4.0	6.9	4.0	5.2
15 or more	5.0	8.6	13.0	16.9
3d. Number of Tutorials				
1	16.0	27.5	2.0	2.6
2	7.0	12.1	23.0	29.9
3	7.0	12.1	12.0	15.6
4	1.0	1.7	13.0	16.9
5	5.0	8.6	4.0	5.3
more than 5	9.0	15.5	23.0	29.9

Table 3 continued

3e. Traditional Labs
Number of Hours

None or No Response	4.0	6.9	0.0	0.0
0-3	2.0	3.9	0.0	0.0
3-5	0.0	0.0	0.0	0.0
5-10	2.0	3.9	2.0	2.6
10-15	4.0	6.9	1.0	1.3
15-20	5.0	8.6	6.0	7.8
20-25	4.0	6.9	12.0	15.6
25-30	3.0	5.1	6.0	7.8
30-50	12.0	20.6	24.0	31.2
50-75	7.0	12.1	12.0	15.6
75-100	3.0	5.1	10.0	13.0
100 or more	2.0	3.9	4.0	5.2

3f. Number of Traditional Labs

1	1.0	1.7	1.0	1.3
2	0.0	0.0	0.0	0.0
3	2.0	3.4	2.0	2.6
4	1.0	1.7	0.0	0.0
5	0.0	0.0	1.0	1.3
5-7	0.0	0.0	0.0	0.0
8-10	1.0	1.7	6.0	7.8
10-20	15.0	25.9	22.0	28.6
more than 20	24.0	41.3	44.0	57.1

4. Mean Number of Hours	Physical Science			Physics		
	N	Mean	SD	N	Mean	SD
Simulations	39	13.0	20.9	71	16.8	20.9
Tutorials/Drill	40	5.6	6.5	71	7.5	12.4
Traditional Lab	40	38.2	25.5	71	44.9	25.7

5. Mean Number of Experiences	Physical Science			Physics		
	N	Mean	SD	N	Mean	SD
Simulations	38	5.0	6.4	68	4.8	4.4
Tutorials/Drill	38	3.8	3.7	69	4.0	4.7
Traditional Lab	44	21.9	9.6	76	22.8	9.2

Table 3 continued

6. Mean Number of Experiences — Combined Physical Science and Physics

	N	Mean	SD
Simulations	106	4.9	5.2
Tutorials/Drill	107	3.9	4.2
Traditional Lab	120	22.5	9.3

7. ANOVA Table For Number of Hours

Source of Variance	DF	Mean Square	F	p
Type of Class	1			
Error Between				
Type of Software	2	32931.91	103.2	0.0001
Type of Class X Type of Software	2	190.46	0.6	0.5514
Error Within	216	319.02		

8. ANOVA Table for Number of Experiences

Source of Variance	DF	Mean Square	F	p
Type of Class	1	0.707	0.01	0.9083
Error Between	102	53.076		
Type of Software	2	10163.460	243.66	0.0001
Type of Class X Type of Software	2	3.267	0.9	0.8760
Error Within	204	41.712		

Table 3 con..nued

9. Number and Percent of Teachers in SubSampie 2 who Listed Software that they Used.

Listed Software		Did Not List Software	
Number	Percent	Number	Percent
68.0	69.4	30.0	30.6

Table 4

Means, Standard Deviations, or Frequencies For Items From Subsample 3

1. Number of Students	Mean	SD	Min	Max
Physics	20.17	26.28	3	110
Physical Science	61.11	57.94	4	140
In School	454.82	376.67	50	2100
In District	2562.36	3367.82	88	9999[1]

2. Percent of the Sample That Teaches at Each Grade Level	Percent
K-Sixth	1.2
Seventh	7.1
Eight	22.6
Ninth	50.0
Tenth	42.8
Eleventh	65.5
Twelfth	75.0

3. Does AEA or School Have Computer Support Person	Percent
Yes	86.9
No	2.4
Don't Know	10.7

4. Have you used Computer Support Person's Services	Percent
Yes	56.1
No	43.9

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1. Only 4 columns were allowed for this variable, so the actual maximum may be greater.

Table 4 continued

5. Peripheral Equipment Available

	Percent
Printer	95.0
Plotter	12.0
Koala Pad	13.0
Mouse	47.0
Light Pen	2.0
Timer Card	1.0
Interface Card for Lab Equipment	42.0
Modem	14.0
Videotape[1]	36.0
Videodisk	8.0

6. Frequencies of Rated Expertise

	Percent or Mean	SD
Word Processing		
never have used	10.1	
introductory familiarity	21.5	
moderate familiarity	46.8	
expert level use	21.5	
mean rating	2.80	0.90
Spreadsheets		
never have used	31.6	
introductory familiarity	29.1	
moderate familiarity	27.8	
expert level use	11.4	
mean rating	2.19	1.01

Table 4 continued

Data Base		
never have used	25.3	
introductory familiarity	32.9	
moderate familiarity	31.6	
expert level use	10.1	
mean rating	2.27	0.95

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1. It is not clear that teachers were refering to videotape or videodisk that could be interfaced with the computer. These values should be interpreted with caution.

Graphics		
never have used	38.0	
introductory familiarity	35.4	
moderate familiarity	21.5	
expert level use	5.1	
mean rating	1.94	0.89
Tutorials in Physics		
never have used	24.4	
introductory familiarity	33.3	
moderate familiarity	39.7	
expert level use	2.6	
mean rating	2.21	0.84
Simulations in Physics		
never have used	24.4	
introductory familiarity	35.9	
moderate familiarity	37.2	
expert level use	2.6	
mean rating	2.18	0.83
BASIC Programming		
never have used	34.6	
introductory familiarity	29.5	
moderate familiarity	23.1	
expert level use	12.8	
mean rating	2.14	1.04

Table 4 continued

Programming in other Language		
never have used	67.5	
introductory familiarity	16.9	
moderate familiarity	13.0	
expert level use	2.6	
mean rating	1.51	0.82
Programming in Assembler		
never have used	89.6	
introductory familiarity	6.5	
moderate familiarity	3.9	
expert level use	0.0	
mean rating	1.14	0.45

7. Mean Rating of Familiarity For Each Type of Software

Word Processing	2.78	0.90	A	
Data Base	2.27	0.90	B	
Tutorials	2.21	0.84	B	C
Spreadsheets	2.19	1.01	B	C
Simulations	2.18	0.83	B	C
BASIC language	2.14	1.04	B	C
Graphics	1.94	0.90		C
Other Prog. Lang.	1.51	0.82	D	
Assembler Language	1.14	0.45	E	

(Items with common letter are not significantly different.)

8. ANOVA Table for Familiarity Rating With Software

Source	DF	Sum of Squares	F	p
Subject	70	228.02	6.62	0.0001
Type of Program	8	143.06	36.37	0.0001
Error	625	307.39		

Table 5

Correlations of Interest in Increased Use of Computers and Interest in Inservice with Number of Students in School and District.

	Interest In Increased Use of Computers	Interest In Inservice on Computers
SubSample 1		
School Size	0.07	0.03
District Size	0.08	0.04
SubSample 2		
School Size	-0.05	-0.09
District Size	-0.20	-0.21
Subsample 3		
School Size	-0.25	-0.32
District Size	0.03	-0.06

Table 6

Correlations between Number of Physics Students, Number of Physical Science Students, School Size, District Size and Other Variables from Subsample 1

		Number of Computers in Lab	Number of Grade Levels Taught	Perceived Value Of		
				Drills	Tutorials	Simulations
Number of Physics Students	R	.17	-.16	-.34	-.20	-.10
	p	.05	.05	.01	.04	.28
	n	121.00	145.00	106.00	103.00	103.00
Number of Physical Science Students	R	.23	-.32	.04	.02	-.02
	p	.01	.01	.65	.80	.77
	n	121.00	145.00	106.00	103.00	103.00
Number of Students in School	R	.32	-.33	-.31	-.18	-.12
	p	.01	.01	.01	.07	.23
	n	117.00	141.00	102.00	99.00	99.00
Number of Students in District	R	.21	-.38	-.34	-.21	-.23
	p	.03	.01	.01	.04	.02
	n	115.00	138.00	101.00	98.00	98.00

Table 7

Correlations between Number of Physics Students, Number of Physical Science Students, School Size, District Size and Number of Grade Level Taught in Subsample 2.

		Number of Grade Levels Taught
Number of Physics Students	R	-.13
	p	.19
	n	96.00
Number of Physical Science Students	R	-.35
	p	.01
	n	96.00
Number of Students in School	R	-.35
	p	.01
	n	96.00
Number of Students in District	R	-.33
	p	.01
	n	76.00

Table 8

Correlations between District Size and Familiarity With Types of Software in Subsample 3.

		District Size
Word Processing		
	R	.56
	p	.01
	n	22.00
Spread Sheets		
	R	-.60
	p	.01
	n	31.00
Data Base		
	R	-.63
	p	.01
	n	15.00
Graphics		
	R	-.50
	p	.01
	n	22.00
Programming In Basic		
	R	.47
	p	.02
	n	22.00
Programming in Other Languages		
	R	.60
	p	.01
	n	22.00

Table 9

Frequency of Textbooks used in Teaching Physics and Physical Science (From Subsample 2)

Physical Science Texts

Title	Author	Publisher	Frequency
Focus on Physical Science	Heimler/Price	Me. ll	22
Modern Physical Science	Tracy et al.	Scott-Fore.	8
Physical Science	Hurd et al.	Prent-Hall	4
Physical Science	Barman et al.	Silv.Burd.	3
ISIS	Burkman et al.	Ginn	3
IPS	Haber	Prent-Hall	2
Physical Science	Eby/Horton	MacMillan	2
General Science	Bishop/Meyer	Merrill	2
General Science	Ramsey et al.	Holt	1
PS Investigations	Bickel/Hogg	Hough-Miff	1
General Science	Hard et al.	Prent-Hall	1
Spaceship Earth Phys. Sci.	Hill/May	Hough-Miff	1
Exper. in Phys. Science	Magnoli	Lardlan	1
Modern Pnys. Science	?	Merrill	1
Modern Chemistry	?	Holt	1

Physics Texts

Title	Author	Publisher	Frequency
Physics: Prin. & Prob.	Murphy et al.	Merrill	33
Modern Physics	Metcalfe/Doll Williams/Trinklein	Merrill	22
Project Physics	Rutherford	Holt	6
Physics Problems	IA Physics Task F.	Merrill	4
Physics	Giancoli	Prent-Hall	4
Conceptual Physics	Hewitt	Addison	3
PSSC	Huber/Schaim	Heath	3
Modern Physics	?	Merrill	1
Physics: Its Models & Mean.	Tabbel	AllynBacon	1
Fundamental of Physics	Martindale et al.	Heath	1

Table 10

Software Used by Teachers in Subsample 2.[1]

Title	Purpose	Publisher	Freq.
Light	Interface-Light Timer	Cross	7
Heat	Interface-Thermoneter	Cross	4
Vectors/Graphing	Practice on Vector Prob.	Cross	2
Statics	Sums of Forces in Statc.	Cross	1
Motion	Projectile & Kinemat.	Cross	3
Conservation Laws	Cons. of Momentum	Cross	2
Circular Motion	Angul. Moment. Tang. Vel	Cross	2
Thermodynamics	T.Heat Eng. Gas Laws	Cross	2
Elect.&Mag	GaussLaw,Circuits	Cross	2
Optics	Mirror Ray, Lens Rays	Cross	1
Atomic Physics	Images,Waves,Diffraction	Cross	2
Solar System Astron.	Decay,Nuc.React.orbits	Cross	1
Stellar Astron	Stars,DeathofStar,Gal.	Cross	1
Cosmology	?	Cross	1
Physics Gems	?	Cross	1
Sound	meas. sound make sound	Cross	1
Collisions	?	Cross	1
Ray Tracer	Optics	Vernier	2
Kinematics	Motion Problems	Vernier	2
GraphingIII Analysis	Graphing	Vernier	12
Frequency Meter	?	Vernier	4
Precision Timer	?	Vernier	7
Temperature Plotter	?	Vernier	5
How to Build A Better Mousetrap	sci. proj. probl. solv	Vernier	1
Voltage Plotter	plot volt. ph meter	Vernier	1
Photogate	meas. light time vel.	Vernier	1
Light	?	Vernier	2
Table 10 continued			
Orbit	physics demos	Vernier	1
Projectiles	physics demos	Vernier	1
Vectors	?	Vernier	1
Heat	?	Vernier	1

1. Entries are based upon the information supplied by teachers and have not been confirmed with information supplied by publishers. A '?' means that the teacher did not supply information for this item. The entry 'Self' under publisher means that the program was created by the teacher.

Laws of Motion	Newton's Laws	EME	3
Laws of Motion:Inc. Pl	Newton's Laws	EME	3
Laws of Motion: A Mach.	Simulation	EME	1
Elements	?	EME	1
Mirrors&Lenses	?	EME	1
Elec. & Magnetism	?	EME	1
Waves & Sound Energy	waves/musical notes	Focus Med.	1
Intro Matter&Energy	vocabulary	Focus Med.	1
Physical Sci:Keywords	vocabulary	Focus Med.	1
Vect.& Linear Motion	?	Focus Med	1
Vectors	vect.add.&navig.pract	EduTech	8
Oil Prop.	reprod. oil drop exp.	Edutech	1
Target	proj. action	Edutech	5
Physics Demo	optics, mechanics	Edutech	1
Optics	ray diagrm analy	Edutech	4
Motion	?	Edutech	1
Waves	super pos. of waves	MECC	1
Heat Loss, Vol 1.	energ.imp.prv.heat loss	MECC	1
Sci. Phys.Chem.V4	Charles,Boyles Law	MECC	1
Sci.Biol.Phys.V2	momentom,vectors,etc	MECC	2
Sci.Vol1	Millikan Oil Drop Exp	MECC	1
Know. Master	simul & drills	MECC	1
Snell's Law	?	MECC	1
Test Maker	test making	MECC	1
Physics	quiz on physics	MECC	1
Ren. ev.Flight.M' ual	Space Shut. Orbit	MECC	1
Tension/Compre... on	Bridge building	MECC	1
Amusement Park Phys	Simul Amuse Park Rides	MECC	1
?	90 Simul. Program	MECC	1
Collide	cons.moment./kine.enrgy	MECC	1
Modeling	?	MECC	1
Vector	?	MECC	1
Zoyon Patrol	Using datab. & prob.s.	MECC	1
Quick Flash	Ion Reviews	MECC	1

Table 10 continued

?	drills & practice	J&S Softw.	2
Free Fall	?	J&S Softw.	1
Projectile	?	J&S Softw.	1
Newton's Laws	?	J&S Softw.	1
Circular Motion	?	J&S Softw.	1
Heat	?	J&S Softw.	1
Gas Laws	?	J&S Softw.	1
Momentum	?	J&S Softw.	1
Waves	?	J&S Softw.	1

Sounds	?	J&S Softw.	1
Acceleration	?	J&S Softw.	1
Uniform Motion	?	J&S Softw.	1
Metric System	?	Compress	1
/Ideal Gases	?	Compress	1
BalancingEEA	?	Compress	1
Sound Interfacing	to see sound waves	HRM	4
Exp. in Science	lay out experiments	HRM	1
Heat & Temperature	?	HRM	1
Motion	?	HRM	3
Fall Guy	?	HRM	1
Discover-Sci. Exper.	set up para. simul.	Sunburst	1
Sir Isaac Newton	Falling bodies	Sunburst	1
Chemistry Series	drill elem. names	Edu. Aud /Vis Inc	1
Fundam. Skills	balancing equations	Edu.Aud /Vis. Inc.	1
Physical Science	Rutherford Exp	Edu.Aud /vis. Inc.	1
Acceleration	?	IBM	1
Atomic Models	?	IBM	1
Electric Fields	?	IBM	1
Energy Conservation	?	IBM	1
Gravitation Force	?	IBM	1
Models of Light	?	IBM	1
Thermal Energy	?	IBM	1
Wave Interface	?	IBM	1
Table 10 continued			
Signif. Figu. Drill	uncertainty	Dreyfus	1
Intro. Gas Laws	?	Dreyfus	1
Sprectral Lines	?	Dreyfus	1
The Astronomy Disk	?	Pren-Hall	1
Physics Disk	physics demos	Pren-Hall	1
Graphics III	graph data	Pasco	1
Precision Time	time runs on airtrk	Pasco	1
Smart Pulley	pulley for a timer	Pasco	1

Chem:cal Elements	elements	Hartley coursewre	1
Chemaid	families of elements	Ventura	1
Timepack	?	Merlan	1
Sky Travel	star/planet locations	Commodre	1
?	vector addition	Tandy	1
Physics	drill	Ideal Lrng	1
AAPT-Wilson Found.	timing, freq, meas.	AAPT	1
Elec. Curr. Models	?	Conduit	1
Test Bank	?	Prisms	1
Chemical Nomenclature	?	Bergwal	1

Table 10 continued

Mind Games	review game	Diversfd	1
Light	vel. of mov. obj	?	1
NSF Loci Project	Physics CAI	?	1
Fred Writer	?	pub. dom	1
Measuring density	?	HaberSchlm	1
GM Sunraycer	use of sun's energy	GM	1
?	t.toring/question	Seraphim	1
Hewitt's Series	Lab Supplement	Add.Wesly	1

Int. Physics Simula.	Problem Solving	Dr.Good	1
Conceptual Physics	Prob. solving	Apple/ laserpoint	1
Basic Concept Elect.	lay out circuits	Medan	1
Three Mile Island	reactor simulator	Muse	1
Appleworks	word processing	Claris	8
Science Tool Kit	Interfacing	Broderbnd	4
?	Calculates work done going up stairs	Self	1
Atom I	calculate Atomic Numb.	Self	1

Table 10 continued

Molec.St[illegible]t.	Structure & Bonding	Self	1
Intro to Circuits	Tutorial on Circuits	Self	1
Indiv. Hmwrk. Assignm.		Self	1
Interface	Timing,Temp. Pressure	Self	1
Air Track Expers.	computations	Self	1
Vectors	Tutorial	Self	1
Inclined Planes	Tutorial	Self	1

Table 11

Categories of Software Used

Category	Use
Interfacing	
light	9
heat	9
Vectors	11
Motion/Kinematics	22
Ccnservation of momentum	5
Circular Motion--Angular Momentum	3
Electrical Circuits and Fields	7
Light and Optics	12
Sound and Waves	6
Astronomy	5
Heat	4
Graphing	13
Orbits	2
Gas.Laws	3

END

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